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Indian Standard

SPECIFICATION FOR DIRECT-CURRENT POTENTIOMETERS

(Second Revision)

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 6 *July* 1981

Indian Standard

SPECIFICATION FOR DIRECT-CURRENT POTENTIOMETERS

(Second Revision)

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Indian Standard

SPECIFICATION FOR DIRECT-CURRENT POTENTIOMETERS

(*Second Revision*)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 28 October 1980, after the draft finalized by the Electrical Instruments Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard was originally issued in 1961 and later revised in 1966. At the time when the first revision was taken up the intention was to add; based on the experience gained, two special grades of dc potentiometers having a least count of 10 μV and 1 000 μV on direct range.

0.3 This second revision is being brought out with a view to introducing precision type direct current potentiometers, which were not originally covered by this standard. In order to align with the current International practice, the potentiometers are classified according to their accuracy classes.

0.4 In the preparation of this standard, assistance has been derived from IEC Pub 523 (1975) 'Direct current potentiometers' published by the International Electrotechnical Commission.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard applies to dc potentiometers assembled from resistors and switches and operating entirely on direct current, having accuracy classes of 0·000 5......0·1 (5 ppm......1 000 ppm). It applies also to auxiliary equipment which is a built-in part of the potentiometer.

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*Rules for rounding off numerical values (*revised*).

1.2 This standard does not apply to potentiometers which are set automatically or semi-automatically nor to those which also employ graduations on the null detector to obtain a part of the indicated value, nor to external auxiliary equipment used with the potentiometer.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 DC Potentiometer (here in-after Designated Potentiometer) — A voltage measuring instrument in which the voltage to be measured is balanced against a known voltage obtained by passing a fixed current through an adjustable resistor or an adjustable current through a fixed resistor, or any combination thereof.

2.2 Measuring Dials — The dials from which, taking into account the range factor, if any, the value of the measured quantity is determined.

2.3 Effective Range — For a specified range factor, the range of dial settings for which the potentiometer can measure with the stated accuracy.

2.4 Range-Changing Device — A device whereby the effective range may be multiplied by a factor (for example 0·1) which is known as the range factor.

2.5 Standardization of a Potentiometer — Adjustment(s) necessary to ensure that a potentiometer is set correctly for measurement.

2.6 Dial Setting — The setting of the measuring dials after balancing the potentiometer, multiplied by the range factor, if applicable, when determining a measured voltage, after standardization of the potentiometer.

2.7 Auxiliary Equipment — Additional equipment, which is or is not an integral part of the potentiometer, necessary to enable the potentiometer to operate accurately and safely as specified.

2.8 Resolution — The voltage corresponding to either one step or the smallest division on the measuring dial of lowest value.

2.9 Circuit Insulation Voltage (Nominal Circuit Voltage) — The highest voltage with respect to earth which may be applied to a circuit of the potentiometer so that the potentiometer is unlikely to become dangerous to touch.

NOTE — Auxiliary circuits (if any) may have different value(s) of circuit insulation voltage (nominal circuit voltage).

2.10 Ripple Content — The ripple content of a dc supply expressed as a percentage of the dc component is:

$$\frac{\text{rms voltage of the fluctuating component}}{\text{dc voltage}} \times 100$$

2.11 Leakage Current Screen (Circuit) — A conductive path which prevents leakage currents from affecting the results of measurements.

2.12 Electrostatic Screen — An electrically conductive enclosure or coating intended to protect the enclosed space from external electrostatic influences.

2.13 Measuring Terminals — The terminals to which the circuit of the voltage to be measured is intended to be connected.

2.14 Measuring Circuit — The internal circuit of the potentiometer which is (or can be) conductively connected to the measuring terminals.

2.15 Measured Quantity Circuit Selector Switch — The switch which selects the set of measuring terminals to be connected to the measuring circuit.

2.16 Residual emf of a Potentiometer — The open circuit voltage present at the measuring terminals due to the potentiometer itself when it is operational and its measuring dials are set to zero.

2.17 Incremental Linearity — The overall linearity of a potentiometer is characterized by both of the following aspects:

a) Constancy of the developed voltage for any two different settings of the measuring dials, each setting indicating the same value; and
b) Constancy of incremental voltage developed between adjacent settings of any one measuring dial.

2.18 Influence Quantity — A quantity, other than the measured quantity, which is liable to cause unwanted variation in the dial setting.

2.19 Common Mode Voltage — A voltage which exists between one of the measuring terminals (called the reference terminal of common mode voltage) and the earth terminal, or the leakage current screen terminal, or the electrostatic screen terminal, separately or collectively (as specified).

2.20 Variation with Influence Quantity — The difference between two measured values for the same measured quantity when an influence quantity assumes successively two different specified values.

2.21 Reference Conditions — The specified conditions under which the potentiometer meets the requirements concerning intrinsic errors.

2.22 Reference Value — A specified single value of an influence quantity at which, within the stated tolerance, the potentiometer meets the requirements concerning intrinsic errors.

2.23 Reference Range — A specified range of values of an influence quantity within which the potentiometer meets the requirements concerning intrinsic errors.

2.24 Nominal Range of Use — A specified range of values which each influence quantity can assume without causing a variation exceeding the specified limits.

2.25 Limiting Values of an Influence Quantity — Extreme values which an influence quantity may assume without the potentiometer being damaged or permanently altered in such a way that it no longer satisfies the requirements of its accuracy class.

2.26 Fiducial Value — A single value for each effective range to which reference is made in order to specify the accuracy of a potentiometer.

Unless otherwise stated by the manufacturer, the fiducial value of a given effective range is the highest integral power of 10 within that range.

Example — A potentiometer having a maximum dial setting of 1·8 V and range factors of 1, 0·1 and 0·01 will have fiducial values of 1·0 V, 0·1 V and 0·01 V respectively.

2.27 Error — Value obtained by subtracting the true value of the measured quantity from the dial setting.

Since the true value cannot be determined by measurement, a value obtained under specified test conditions and at a specified time is used instead. This value is traceable to national measurement standards or to measurement standards agreed upon by manufacturer and user

NOTE — The error due to any auxiliary equipment which is not built-in to the potentiometer is not included in the error of the potentiometer.

2.28 Intrinsic Error — An error determined under reference conditions.

2.29 Accuracy — The accuracy of a potentiometer is defined by the limits of intrinsic error and the limits of variations due to influence quantities.

2.30 Accuracy Class — A class of potentiometers the accuracy of all of which can be designated by the same number if they comply with all the requirements of this standard.

2.31 Class Index — The number which designates the accuracy class.

3. CLASSIFICATION

3.1 Potentiometers specified in this standard are classified according to their accuracy classes (*see* **2.30**) as follows:

a) 0·000 5, 0·001, 0·002, 0·005, 0·01, 0·02, 0·05, 0·1 percent; and
b) 5, 10, 20, 50, 120, 200, 500, 1 000 ppm.

The class index of a potentiometer may be expressed either in percentage using (a) or in ppm using (b) or both.

3.1.1 If a potentiometer has several measuring ranges, each range may have its own class index.

4. GENERAL REQUIREMENTS

4.1 Materials

4.1.1 The potentiometer coils shall be constructed from resistance material having a negligible temperature coefficient of resistance and negligible thermo-emf against copper. The coils after being wound, shall be thoroughly aged.

4.1.2 Materials used in the construction shall be adequately protected against oxidation and corrosion and shall have adequate mechanical strength.

4.2 Workmanship and Finish

4.2.1 The potentiometer shall be robust in construction and shall present a good finish.

4.2.2 Paint, lacquering or any other surface finish shall be hard and smooth so that cleaning of accumulated dust shall be facilitated.

4.2.3 The box shall be so constructed as to prevent, as far as practicable, dust from getting into the internal mechanism either through the joints or through the holes for control knobs, binding posts, etc. Sealing by felt or other similar washers or dust-preventing caps is recommended.

4.2.4 If the potentiometer is intended to work immersed in oil, the box shall be suitably designed for holding the oil with arrangements for filling and draining.

4.2.5 All exposed terminals shall be treated to withstand oxidation and corrosion. The guard terminal will be necessary when used in very high sensitive electronic galvanometer.

4.2.6 All individual resistors shall be treated to be moisture resistant.

4.2.7 Soldering and brazing shall preferably be done with non-corrosive flux. When a corrosive flux is ued, it shall be completely removed. Soldered joints shall present a smooth and continuous appearance. All excess solder and flux shall be removed.

4.2.8 Spring washers and locknuts or similar devices should preferably be used especially for fixing binding posts so that they do not become loose on repeated turning and twisting normally met with in usage.

4.2.9 The knobs shall be held on the shafts by at least two screws. Any alternative design may be used to prevent slipping.

4.2.10 A circuit diagram giving the nominal values of all components shall accompany each potentiometer. In the case of single-sheet diagram, it should either be mounted or placed in a stiff envelope which is attached to the potentiometer with a string or be part of a booklet accompanying the potentiometer. A certificate of tests for the potentiometer shall also be provided by the manufacturer, if the agreement between the purchaser and the supplier so provides.

4.3 Accessories

4.3.1 The essential accessories of a potentiometer are: (a) the standard cell; (b) the detecting galvanometer; (c) the galvanometer sensitivity control (that is, a variable resistance); and (d) the battery. Other accessories, such as ' current shunts ' and ' voltage multiplier ' are generally supplied separately.

5. TECHNICAL REQUIREMENTS

5.1 Limits of Intrinsic Error

5.1.0 Potentiometers shall comply with the relevant limits of intrinsic error specified for their respective accuracy classes for the duration of one year from the date of certification associated with delivery or another date to be agreed upon by the manufacturer (or responsible supplier) and the user, provided that the conditions of use, transport and storage specified by the manufacturer are complied with.

NOTE — For potentiometers, stability with regard to time is an essential characteristic. Here, it is specified only for the duration of one year but experience has shown that the rate of change due to ageing effects decreases with time.

5.1.1 *Permissible Limits of Intrinsic Error* — The permissible limits of error of a potentiometer are composed of two parts:

a) constant term related to the fiducial value, and

b) variable term proportional to the dial setting.

The two limits are given by the positive and negative values, respectively, of the binomial formula:

$$E_{\mathrm{lim}} = \pm \frac{c}{100}\left(\frac{U_{\mathrm{n}}}{10} + X\right)$$

where

E_{lim} = the permissible limit value of the error, expressed in volts;
U_{n} = the fiducial value, expressed in volts;
X = the dial setting, expressed in volts; and
c = the class index, expressed as a percentage.

When the class index c is expressed in ppm the formula given below shall be used:

$$E_{\text{lim}} = \pm \frac{c}{1\,000\,000}\left(\frac{U_n}{10} + X\right)$$

5.1.2 *Incremental Linearity* — The difference in error corresponding to the same value of the measured quantity obtained by any two dial settings shall not exceed half of the permissible limit of intrinsic error.

The difference in error between any two adjacent dial settings on any one measuring dial shall not exceed half of the average of the permissible limits of intrinsic error of the same sign for these settings.

5.1.3 *Resolution* — The resolution shall not have a value exceeding:

$0{\cdot}5 \, \frac{c}{10} \, U_n$ if the class index c is expressed in percentage,

or

$0{\cdot}5 \, \frac{c}{1\,000\,000} \, U_n$ if the class index c is expressed in ppm.

5.1.4 *Range-Changing Device* — The manufacturer shall specify if restandardization of the potentiometer is necessary on changing the range.

5.1.5 *Independent Circuit for Standardization of a Potentiometer* — If a potentiometer can be standardized on any range by means of an independent circuit without the use of the measuring dials, the additional error introduced by such standardization shall not exceed half of the permissible intrinsic error.

5.2 Reference Conditions and Tolerances of the Influence Quantities

5.2.1 The reference values relative to each of the influence quantities are shown in Table 1.

5.3 Permissible Limits of Variation

5.3.1 When the potentiometer is under the reference conditions given in Table 2 and single influence quantity is varied in accordance with **7.4**, the variation shall not exceed the values specified in Table 2.

TABLE 1 REFERENCE CONDITIONS AND TOLERANCES OF THE INFLUENCE QUANTITIES

(*Clause* 5.2.1)

INFLUENCE QUANTITY	REFERENCE CONDITIONS UNLESS OTHERWISE INDICATED BY THE MANUFACTURER	CLASS INDEX		TOLERANCE PERMITTED FOR TESTING PURPOSE*
		Percent	ppm	
(1)	(2)	(3)	(4)	(5)
Ambient temperature	27°C	0·000 5... 0·001	5 ... 10	± 0·5°C
		0·002 ... 0·01	20 ... 100	± 1°C
		0·02 ... 0·1	200 ... 1 000	± 2°C
Relative humidity, percent	40 to 60			
Position	Any			
Ripple content†	Less than 0·1 percent			
Common mode voltage	Zero	0·000 5 ... 0·1	5 ... 1000	± 0·1 of the fiducial value
Period of connection to auxiliary supplies prior to measurement‡	At least 5 minutes			

*For a reference range, no tolerance is allowed.

†This relates to the ripple content of each associated external dc supply to the ripple of the external voltage reference source (if any) and to the ripple superimposed on the measured quantity.

‡The effects of changes in the dc supplies are not taken into account. They are normally removed by the process of standardization.

TABLE 2 LIMITS OF THE NOMINAL RANGE OF USE AND PERMISSIBLE VARIATIONS

(*Clause* 5.3.1)

INFLUENCE QUANTITY	CLASS INDEX		LIMITS OF NOMINAL RANGE OF USE UNLESS OTHERWISE INDICATED BY THE MANUFACTURER	PERMISSIBLE VARIATION*
	Percent	ppm		
(1)	(2)	(3)	(4)	(5)
Ambient temperature	0·000 5 .. 0·001	5 ... 10	Reference value ± 2°C	20
	0·002 ... 0·01	20 ... 100	Reference value ± 5°C	50
	0·02 ... 0·1	200 ... 1 000	Reference value ± 10°C	100
Relative humidity	0·000 5 0·1	5 ... 1 000	25 percent and 75 percent	30
DC common mode voltage	0·000 5 ... 0·1	5 ... 1 000	± 10 V†	50

*Expressed as a percentage of the permissible intrinsic error.

†The resistance of the external circuit, that is the resistance seen from the two terminals between which the measured quantity is applied shall not exceed 10 kΩ.

5.4 Insulation Resistance

5.4.1 The minimum value of insulation resistance measured according to the method specified in **7.2** shall not exceed the values specified in Table 3.

TABLE 3 MINIMUM VALUES OF INSULATION RESISTANCE

Class Index		Minimum Value of Insulation Resistance
Percent	ppm	
0·000 5 .. 0·001	5 ... 10	10 GΩ
0·002 ... 0·01	20 ... 100	1 GΩ
0·02 ... 0·1	200 ... 1 000	100 MΩ

5.5 Measured Quantity Circuit Selector Switch

5.5.1 Measured quantity circuit selector switches, if any, shall switch all poles of all measured quantity circuits. The several measured quantity circuits shall not be connected together, even momentarily, during operation of the switch.

5.6 Rheostats for Standardization of the Potentiometer

5.6.1 If internal rheostats are provided, they shall be smooth and continuous in operation and shall have a fineness of adjustment such that the potentiometer current can be set with a resolution less than or equal to 10 percent of the value corresponding to the class index.

5.7 Limiting Temperature for Storage, Transport and Use

5.7.1 Unless otherwise stated by the manufacturer, potentiometers shall be capable of withstanding, without damage, exposure to ambient temperatures within the range – 10°C to + 50°C. After returning to reference conditions, the potentiometers shall meet the requirements of this standard.

NOTE 1 — If potentiometers are installed in racks or test desks, care should be taken to ensure that the ventilation required for their operation is not impeded.

NOTE 2 — If the potentiometer incorporates a standard cell or other devices which could be damaged by temperature, the manufacturer may state other values.

6. MARKING AND INFORMATIVE LABELLING

6.1 Information

6.1.1 The following information shall be given by the manufacturer:

a) Manufacturer's name or mark or that of the responsible supplier;

b) Type reference given by the manufacturer or responsible supplier;

c) Serial number;

d) Effective range, resolution and measuring range factor(s);

e) Class index (indices);

f) Reference value and nominal range of use for temperature if different from those given in Tables 1 and 2;

g) Where relevant, reference position and nominal range of use for position;

h) Where relevant, essential parameters of the auxiliary equipment, in particular those of the voltage reference source and current supply apparatus;

j) Procedure for standardization and use of the potentiometer;

k) Circuit diagram, values of components and list of replaceable parts;

m) Reference value (range) and nominal range of use for other influence quantities [*see* (f) and (g)], if different from those given in Tables 1 and 2; and

n) Test voltage.

6.1.2 If a certificate is supplied by agreement between the manufacturer or responsible supplier and the user, it shall contain the following information:

a) Certified values together with their uncertainties;

b) Date of certification; and

c) Designation of certifying authority.

6.2 Markings, Symbols and Their Locations — The markings and symbols shall be legible and indelible. Recommended symbols are shown in Appendix A.

6.2.1 The following information shall be marked on a nameplate or on the case:

a) Manufacturer's name or mark or that of the responsible supplier;

b) Type reference given by the manufacturer or supplier;

c) Serial number;

d) Class index (indices) using symbol E-7 or E-8;

e) Reference position and nominal range of use of position; and

f) Test voltage using symbols C-1 to C-3.

6.2.2 All terminals shall be marked to show polarity (where relevant), function and characteristics of the supply source.

In particular, the following terminals shall be identified by a marking adjacent to the terminal:

a) Measuring terminals;

b) Terminals for connection to auxiliary equipment;

c) Earth terminal, if any (using symbol F-31);

d) Terminal(s) of the leakage current screen (*circuit*), *if any*; and

e) Terminal of the electrostatic screen, if any.

6.2.3 The following information shall be given either on the nameplate or on the case or in a separate document:

a) Effective range, resolution and measuring range factor(s);

b) Reference value and nominal range of use for temperature if different from those given in Tables 1 and 2; and

c) Reference value (range) and nominal range of use for other influence quantities, if different from those given in Tables 1 and 2.

6.3 Documentation

6.3.1 The documentation shall state:

a) Manufacturer's name or mark or that of the responsible supplier;

b) Type reference given by the manufacturer or responsible supplier;

c) Serial number;

d) Where relevant, essential parameters of the auxiliary equipment in particular those of the voltage reference source and current supply apparatus;

e) Procedure for standardization and use of the potentiometer;

f) Circuit diagram, values of components and list of replaceable parts;

g) Effective range, resolution and measuring range factors;

h) Reference value and nominal range of use for temperature if different from those given in Tables 1 and 2; and

j) Reference value (range) and nominal range of use for other influence quantities [*see* (f) and (g)], if different from those given in Tables 1 and 2

NOTE — Information given in (g), (h) and (j) above shall be stated if these are not marked on the nameplate or on the case (*see* **6.2.3**).

6.3.2 The certificate referred to in **6.1.2** when supplied, shall state:

a) Certified values together with their uncertainties;

b) Date of certification; and

c) Designation of certifying authority.

NOTE — An example of marking of a potentiometer is given in Appendix B.

7. TESTS

7.1 General

7.1.1 *Type Tests* — The following shall constitute type tests:

a) Insulation resistance test (**7.2**);
b) Voltage tests and tests for other safety requirements (**7.3**);
c) Tests for the determination of intrinsic errors (**7.4**);
d) Tests for the errors due to temperature variation (**7.5**); and
e) Mechanical endurance test (**7.6**).

7.1.2 *Routine Tests* — The following shall constitute routine tests:

a) Insulation resistance test (**7.2**), and
b) Tests for determination of intrinsic errors (**7.4**).

7.2 Insulation Resistance Test — The values of dc insulation resistance measured at 500 V dc ± 10 percent between any two points which are not intended to have any connection between them, shall not be less than the values given in Table 3. The measurement shall be made between 1 minute and 2 minutes after the application of the voltage.

7.3 Voltage Tests and Tests for Other Safety Requirements — The relevant provisions specified in IS : 9249 (Part I)-1979* shall apply.

7.4 Tests for the Determination of Intrinsic Errors

7.4.1 *Conditions of Determination* — Before any measurement, sufficient time shall elapse for the potentiometer to reach a stable state and to be in equilibrium with the reference value of the influence quantities. The leakage current screen and the electrostatic screen, if any, shall be connected in accordance with the manufacturer's instructions.

7.4.2 *Determination of Variance* — Variations shall be determined for each influence quantity. During each determination, all other influence quantities shall be maintained at their reference conditions. The variation is assessed as follows:

When a reference value is assigned to the potentiometer, the influence quantity shall be varied between that value and any value within the limits of the nominal range of use as given in Table 2.

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*Safety requirements for indicating and recording electrical measuring instruments and their accessories: Part I Common safety requirements for instruments.

When a reference range and a nominal range of use are assigned to the potentiometer, the influence quantity shall be varied between each of the limits of the reference range and any value in that part of the nominal range of use adjacent to the chosen limit of the reference range.

NOTE — For routine test, this test shall be carried out at 20, 40, 60, 80 and 100 percent of the range of the potentiometer.

7.4.3 *Determination of the Effect of a Common Mode Voltage* — The effect of a common mode voltage may depend on the resistance of the external circuit of the measured quantity.

The effect of a common mode voltage may be determined:

a) either by the direct method given in Appendix C, or

b) by the indirect method given in Appendix D.

If the potentiometer enclosure is made of insulating material, a conductive supporting plate is used instead of the earth terminal.

Tests to determine the effect of a common mode voltage are to be carried out by agreement between manufacturer and user.

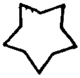
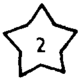
7.5 Test for the Errors due to Temperature Variation — The values measured in **7·4** shall be re-measured at temperature of 5°C above and below the temperature of calibration and the error shall not exceed twice the allowable percentage error or twice the least count, whichever is greater.

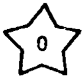
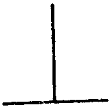
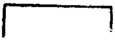
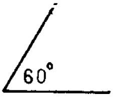
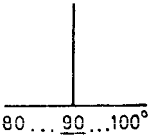
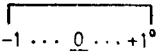
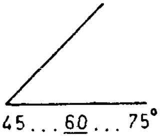
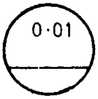
7.6 Mechanical Endurance Test — Life of the switch, keys and contact shall be tested by actual operation of the switches 10 000 times. After 10 000 operations, there shall be no mechanical deterioration in their working.

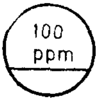
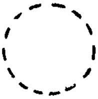
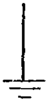
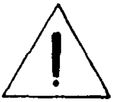
APPENDIX A

(*Clause* 6.2)

SYMBOLS FOR MARKING POTENTIOMETERS

No.	*Item*	*Symbol*
C-1	Test voltage 500 V	
C-2	Test voltage above 500 V (for example 2 kV)	

No.	*Item*	*Symbol*
C-3	Apparatus not subjected to a voltage test	
	Position of use	
D-1	Potentiometer to be used with the supporting surface vertical	
D-2	Potentiometer to be used with the supporting surface horizontal	
D-3	Potentiometer to be used with the supporting surface inclined (for example 60°) from the horizontal plane	
D-4	Example for potentiometer to be used as D-1 Nominal range of use 80°...100°.	
D-5	Example for potentiometer to be used as D-2 Nominal range of use – 1°...+ 1°.	
D-6	Example for potentiometer to be used as D-3 Nominal range of use 45°...75°.	
	Accuracy class	
E-7	Class index with errors expressed as a percentage (for example 0·01) when the permissible error is proportional in part to the fiducial value and in part to the dial setting.	

No.	*Item*	*Symbol*
E-8	Class index with errors expressed in parts per million (for example 100 ppm) when the permissible error is proportional in part to the fiducial value and in part to the dial setting.	
	General symbols	
F-27	Electrostatic screen	
F-31	Earth terminal	
F-33	Refer to a separate document	
F-41	Leakage current screen	Under consideration

APPENDIX B

(*Clause* 6.3.2)

EXAMPLE OF THE MARKING OF A POTENTIOMETER

B-1. The example of the markings given below provide the following information:

a) dc potentiometer, type A, B, C, D, serial number 1, 2, 3, 4 and 5 manufactured by N. N.

b) The class index: 0·01 or 100 ppm.

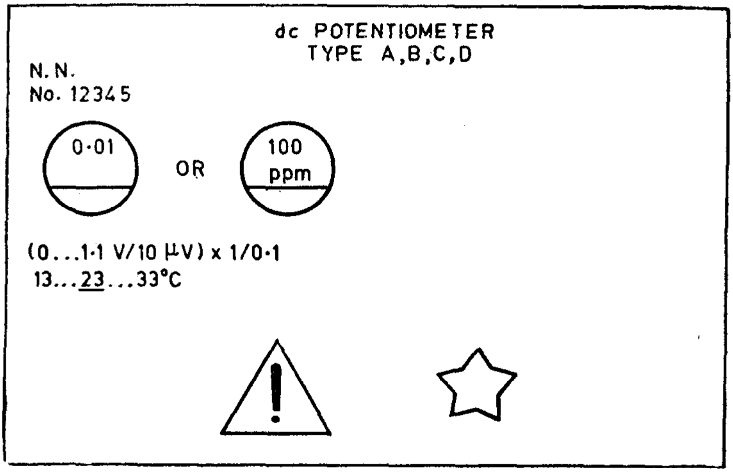
c) —range factor 1:

effective range (0...1·1 V) × 1·1 Resolution 10 μV.

—range factor 0·1:

effective range (0...1·1 V) × 0·1 Resolution 1 μV.

d) Reference value of temperature: 23°C.
Nominal range of use: from 13°C to 33°C.
(These values are shown because they are different from those specified in Tables 1 and 2.)
e) Further essential information is given in a separate document.
f) The test voltage is 500 V.



APPENDIX C

(*Clause* 7.4.3)

DETERMINATION OF THE EFFECT OF COMMON MODE VOLTAGE — DIRECT METHOD

C-1. The effect of a common mode voltage is obtained directly by determining the variation caused in the dial setting for a given measured quantity when a common mode voltage is applied to one of the measuring terminals.

The specified value of common mode voltage is applied between each of the measuring terminals and the enclosure of the potentiometer when it is conductive or, when the enclosure is made of insulating material, a conductive supporting plate.

C-2. All precautions should be taken so that the leakage resistances of auxiliary equipment cannot affect the results of the test. Auxiliary equipment which is not incorporated in the potentiometer, such as:

a) standard cell,
b) null detector, and
c) power supply.

as well as the external measuring circuit, should be carefully insulated from the enclosure of the potentiometer (or from the conductive plate).

When it is impossible to avoid the use of external devices or of a measuring circuit having an auxiliary ac source, all precautions should be taken to prevent coupling from ac circuits from affecting the results of the test.

C-3. When the potentiometer itself has a leakage current screen, it should be connected in accordance with the manufacturer's instructions. In the absence of a statement to the contrary by the manufacturer, the electrostatic screen, if any, should be connected to the enclosure and to earth.

The determination of the effect of the common mode voltage should be carried out:

a) with substantially zero resistance of the external measuring circuit; and
b) with a resistance of about 10 kΩ of the external measuring circuit, the common mode voltage being applied in turn to both of the measuring terminals.

This test is carried out using at least three values of the measured quantity spread over the effective range. Each test is carried out using both polarities of the common mode voltage.

The variation is given by the difference between the values obtained above and those obtained in the absence of a common mode voltage, all other test conditions remaining unchanged.

The variation shall not exceed the values given in Table 2.

APPENDIX D

(*Clause* 7.4.3)

DETERMINATION OF THE EFFECT OF COMMON MODE VOLTAGE — INDIRECT METHOD (SUPERPOSITION METHOD)

D-0. The superposition method often proves to be more practical than the direct method described in Appendix C.

D-1. This indirect method is based on the general principle of superposition of states of balance and, in this case, the determination of the influence of a common mode voltage is affected without energizing the internal measuring circuit of the potentiometer.

The terminals for the connection of the dc supplies are short-circuited. When the auxiliary supply source is internal, it is necessary first to open its circuit on one side.

The potentiometer null detector should be used as in normal operation. When the null detector is not internal, it is connected in the normal way to the potentiometer terminals, but all essential precautions shall be taken to ensure suitable insulation from the enclosure of the potentiometer (or from the conductive plate on which it is placed) and, when necessary, from the dc supplies. In general, all precautions should be taken so that the leakage resistance of testing apparatus and of the external auxiliary equipment cannot affect the result.

D-2. When the potentiometer has a built-in switch between the internal measuring circuit and one of the null detector terminals or one of the terminals of the external measuring circuit, this switch shall be closed when this test is being carried out.

Two tests are carried out using the specified value of common mode voltage:

a) the two measuring circuit terminals are short-circuited and the common mode voltage is applied between these two terminals and the enclosure of the potentiometer (or the conductive plate on which it is placed),

b) a resistance of 10 kΩ is connected between the two measuring circuit terminals. The common mode voltage is applied in turn to one terminal and then to the other.

Both tests are carried out for both polarities of the common mode oltage and all using at least three dial settings distributed throughout the ffective range.

The variations measured by the null detector in relation to the alues measured in the absence of the common mode voltage shall not xceed the values given in Table 2.

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